A California Clean-Car Financing Program for Light-Duty Vehicles

The untapped potential for cost-effective reduction of vehicle emissions

The California Air Resources Board (CARB) plans to employ several regulatory measures for controlling light-duty vehicle (LDV) emissions. These include the established Pavley regulations ("Pavley I"), extended Pavley regulations ("Pavley 2"), and the Low-Carbon Fuel Standard.[1] These three measures (or comparable federal regulations) are expected to reduce California's LDV emissions in 2020 to a level 13 percent higher than the 1990 level.[2] This would not be sufficient to keep pace with the state's goal of reducing statewide emissions to 80% below the 1990 level by 2050[3], but CARB's economic modeling suggests that significantly greater reductions would be feasible and cost-effective.

CARB's Scoping Plan for AB 32 implementation indicates that strengthening the Pavley I regulations (with more stringent Pavley II regulations) would provide incremental net savings of $262/MT to vehicle owners.[4] However, the Pavley II regulations, like Pavley I, would not be able to fully exploit the untapped potential of cost-effective vehicle emission reductions because it is not possible to reliably predict the limits of feasibility and cost effectiveness years or decades into the future. (For example, hybrid vehicle technologies were considered to be economically "infeasible" for the purpose of establishing the Pavley I requirements,[5] but hybrid costs could fall by two thirds over the next decade[6].)

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[1] AB 32 Scoping Plan (December, 2008) [http://www.arb.ca.gov/cc/cc.htm]

[2] Passenger-vehicle emissions in California amounted to 106 MMT in 1990, and are projected to be 120 MMT in 2020 with Pavley I, Pavley II, and the LCFS.
April 21, 2008 ARB/ITS-Davis Symposium [http://www.arb.ca.gov/cc/ccms/workshops.htm]:
"Reducing Greenhouse Gas Emissions from Passenger Vehicles 'What's Next'?"
[http://www.arb.ca.gov/cc/ccms/meetings/042108/arb_its-davis_vehghgsymp_042108.pdf]

[3] Executive Order S-3-05, June 1, 2005 [http://gov.ca.gov/executive-order/1861/]

[4] based on the Draft Scoping Plan, Economic Analysis Supplement, Appendix 1, Table I-2
[http://www.arb.ca.gov/cc/scopingplan/document/economic_appendix1.pdf]

[5] "At this time, staff is projecting that high volume production of advanced hybrids will not be accomplished before the 2017 timeframe. The complexity of these vehicles and the significant increase in resources to engineer and fully develop them will require a more gradual roll out than for more conventional technologies. …"
[August, 2004 ISOR, page 56, http://www.arb.ca.gov/regact/grnhsgas/isor.pdf]

[6] "Hybrid Production Cost May Drop by Two-Thirds Over Next Decade,"
by Makiko Kitamura, Oct. 17, 2008
[http://www.bloomberg.com/apps/news?pid=20601207&sid=aUj9rsy0Q878]

Incentive-type policies such as vehicle feebates could overcome the limitation of predictive uncertainty by providing stable price incentives for emission reduction. (The incentives would not cease after a predetermined performance standard has been achieved.) CARB is considering feebates as an alternative to Pavley II[7], but it may not be practicable or politically feasible to create feebate incentives approaching the limits of feasibility and cost effectiveness because of the "wealth transfer" that feebates create from less-efficient to more-efficient vehicles.

Vehicle financing incentives

In principle, LDV regulatory incentives should not need to rely on financial penalties (fees) and subsidies (rebates) to motivate emission reductions, because the economic benefits of fuel savings alone can fully offset technology costs. Clean-car financing incentives could overcome the propensity of consumers to neglect or undervalue lifecycle operating costs in their vehicle purchase decisions, and could induce capital investment in low-carbon vehicle technologies beyond what would be achievable with standards or feebates.

The advantage of financing incentives over penalties and subsidies for incentivizing low-carbon technology is illustrated by the Berkeley FIRST program, which uses long-term (20-year) municipal bonds[8] to finance residential solar installations. Unlike subsidy incentives, financing can defray the entire capital cost for solar installations. The Berkeley FIRST financing model is supported by recent legislation[9], and is being adopted by other cities.[10]

A similar approach could be applied in the LDV market to eliminate the price barrier to low-carbon vehicle technologies. Commercial financing would not be required; instead the program could obtain financing from refundable fees on high-emission vehicles. The program would operate much like a feebate, except that rebates would be repayable loans, and fees would resemble investments. Loan payments for low-emission vehicles would be offset by operating cost savings, whereas fee refunds for high-emission vehicles would be offset by their higher operating costs.

In contrast to a traditional financing instrument, feebate-type loans would not be implemented to generate profits for investors (or losses for borrowers).

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[7] CARB Feebates Research Contract [http://www.arb.ca.gov/research/econprog/feebates/feebates.htm]

[8] Renewable Funding, LLC [http://www.renewfund.com/]

[9] California Assembly Bill 811 (Levine, 2008) [http://www.legislature.ca.gov/]

[10] "Cities go big with solar financing," by Sara Stroud, May 4, 2009, in *Sustainable Industries* [http://www.sustainableindustries.com/breakingnews/44082122.html?viewAll=y]

The loans would only function to neutralize operating costs differences between vehicles having comparable utility characteristics, so that differences in lifecycle operating costs are fully reflected in up-front costs. Thus, a buyer who neglects operating cost benefits of efficient vehicles would value efficient vehicles no differently from a buyer who fully considers long-term operating cost benefits.

An illustrative example of clean-car financing

Consider two comparable vehicles, a 50-mpg hybrid and a 30-mpg non-hybrid having respective sales prices of $25,000 and $20,000. The discounted lifecycle fuel costs are estimated at $8,000 for the hybrid and $13,000 for the non-hybrid.[11] Both vehicles have the same total cost ($33,000), as illustrated in Figure 1. But although the hybrid's lower fuel cost fully offsets its higher sale price, consumers do not generally value lifecycle fuel savings in their purchase decisions, or they are deterred by the high capital investment cost, so the $5,000 price barrier limits the hybrid's marketability.

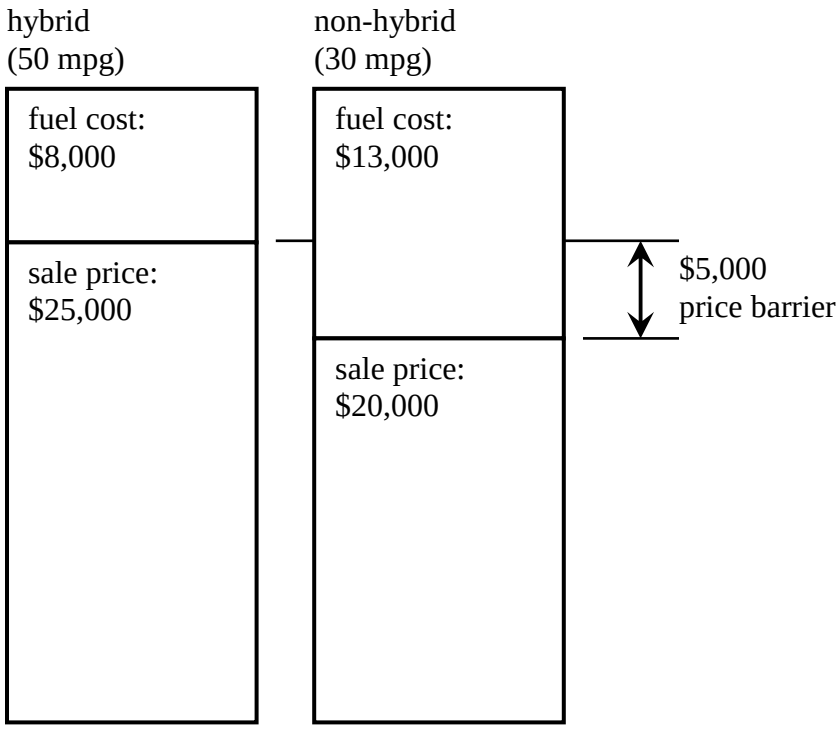

Figure 1. No regulatory incentive

[11] In this example, lifecycle fuel costs are estimated using a three-year average price of California regular gasoline, which is currently approximately $3/gal. (A three-year average was used to define CARB's cost-effectiveness criterion in developing the Pavley 1 regulations.) Using a real discount rate of 5% and a 16-year vehicle lifetime, the present value of lifecycle fuel costs (at the time of vehicle purchase) would be a little over $2/gal. Also, the lifecycle fuel costs assume 200,000 vehicle miles traveled.

A feebate can be applied to neutralize the sale price difference. For example, a $2500 fee applied to the non-hybrid, and a $2500 rebate applied to the hybrid, would eliminate the price barrier as illustrated in Figure 2. However, the $2500 “wealth transfer” from the non-hybrid to the hybrid limits the policy’s political viability. The wealth transfer could be justified by the hybrid’s lower environmental cost, but fuel savings alone should suffice to offset the hybrid’s price handicap.

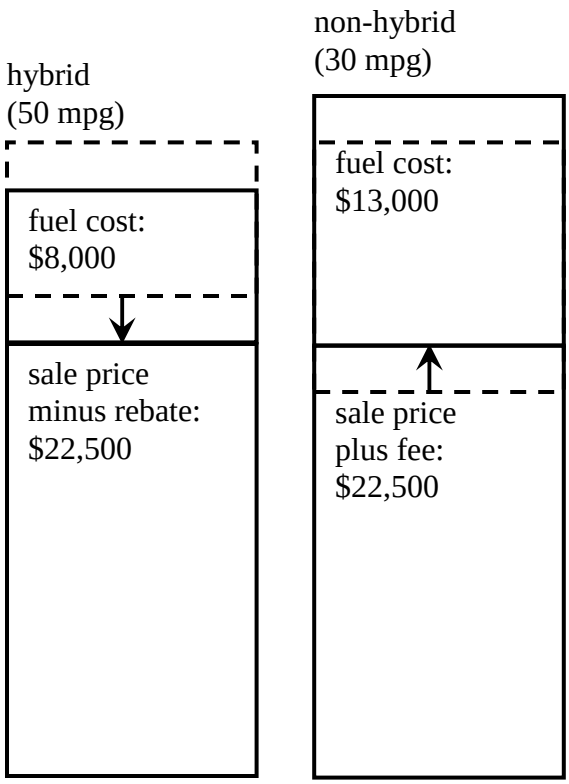

Figure 2. Feebate incentive

An alternative approach, which avoids the wealth transfer, is to implement feebates as a loan-type financing instrument. Rebates are implemented as long-term loans; and fees, which provide loan financing, are refundable over the vehicle lifetime. The rebate loans are, in effect, paid from fuel savings, and fees effectively pre-pay a portion of a vehicle’s lifecycle fuel costs. This is illustrated in Figure 3. (All dollar values in the figures are discounted present values.)

The loan payments and fee refunds effectively levelize operating costs between the two vehicles (Figure 3) so that the difference in lifecycle fuel costs is fully internalized in the up-front vehicle cost (sale price plus feebate). This ensures that vehicle owners will fully consider operating cost savings in their choice preferences.

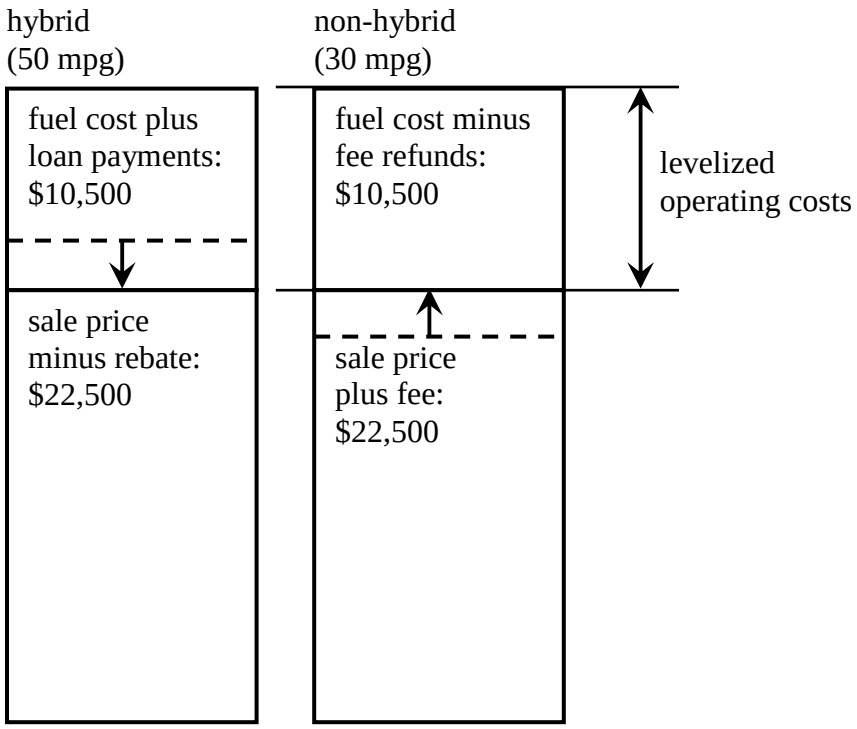

Figure 3. Financing incentive

Vehicle performance benchmarking

As with a conventional feebate, the clean-car financing incentive would rate vehicles against an emission performance benchmark. Vehicles that outperform the benchmark would qualify for rebate loans, while those that underperform would be subject to refundable fees. If a uniform emission benchmark (grams-CO_2 per mile) is applied, it would have the effect of levelizing operating costs for all vehicles, as illustrated in Figure 4. The figure compares costs for two small cars (hybrid and non-hybrid) and two SUV's (hybrid and non-hybrid), showing the split between the initial cost (sale price plus feebate) and long-term operating cost (fuel costs plus loan payments or minus fee refunds). The dashed lines show the cost split without the financing incentive.

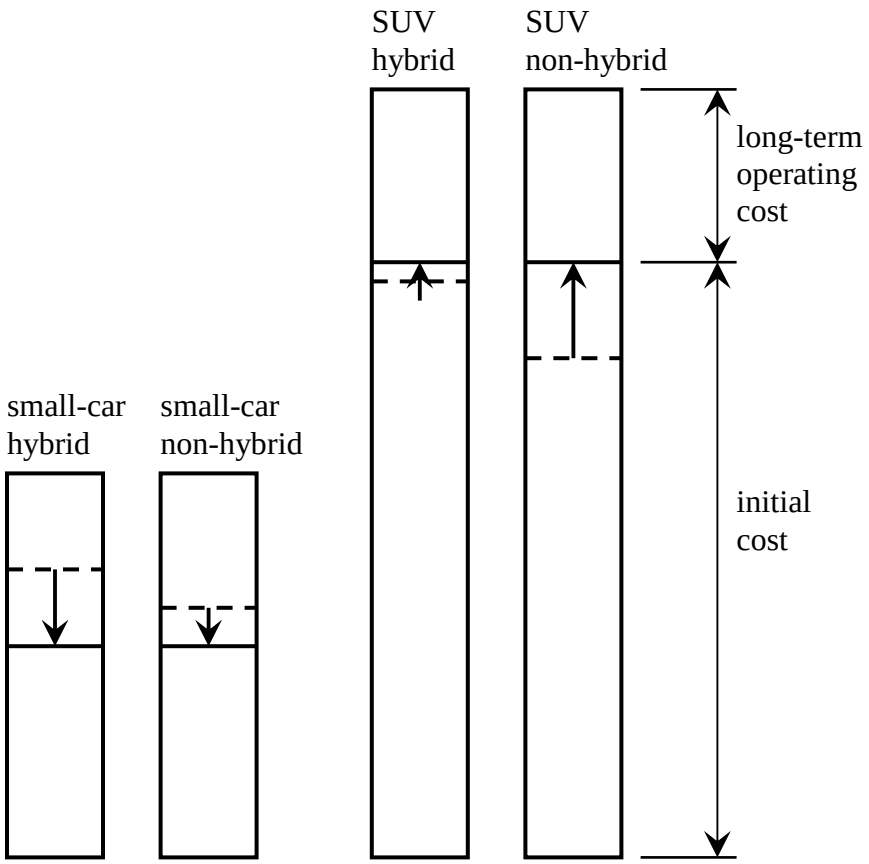

Figure 4. Financing incentive with uniform benchmark

With a uniform benchmark, small vehicles – even those with relatively poor emission performance – would qualify for rebates, while SUV hybrids could be subject to fees. The overall effect of the policy would be to increase the spread in initial costs between large and small vehicles. The financing incentive would tend to induce downsizing; but consumers and manufacturers would resist any inducement to sacrifice utility in favor of emission performance[12], and even with fee refunding the feebate disparity between small and large vehicles might be politically unviable.

A class-dependent or attribute-dependent benchmark could be employed to minimize large feebate revenue flows between vehicle utility classes. As illustrated in Figure 5, this approach would operate to levelize operating costs between vehicles within the same utility class (e.g. between hybrid and non-hybrid cars, or between hybrid and non-hybrid SUV's), but would not enforce levelized operating costs between different utility classes (e.g., cars and SUV's).

[12] See Sec. 4.5 in "Feebates, rebates and gas-guzzler taxes: a study of incentives for increased fuel economy," D.L. Greene et al., Energy Policy Volume 33, Issue 6, April 2005, Pages 757-775 [http://dx.doi.org/10.1016/j.enpol.2003.10.003] [http://www-cta.ornl.gov/cta/Publications/Reports/FeebateEnergyPolicy_FINAL.pdf]

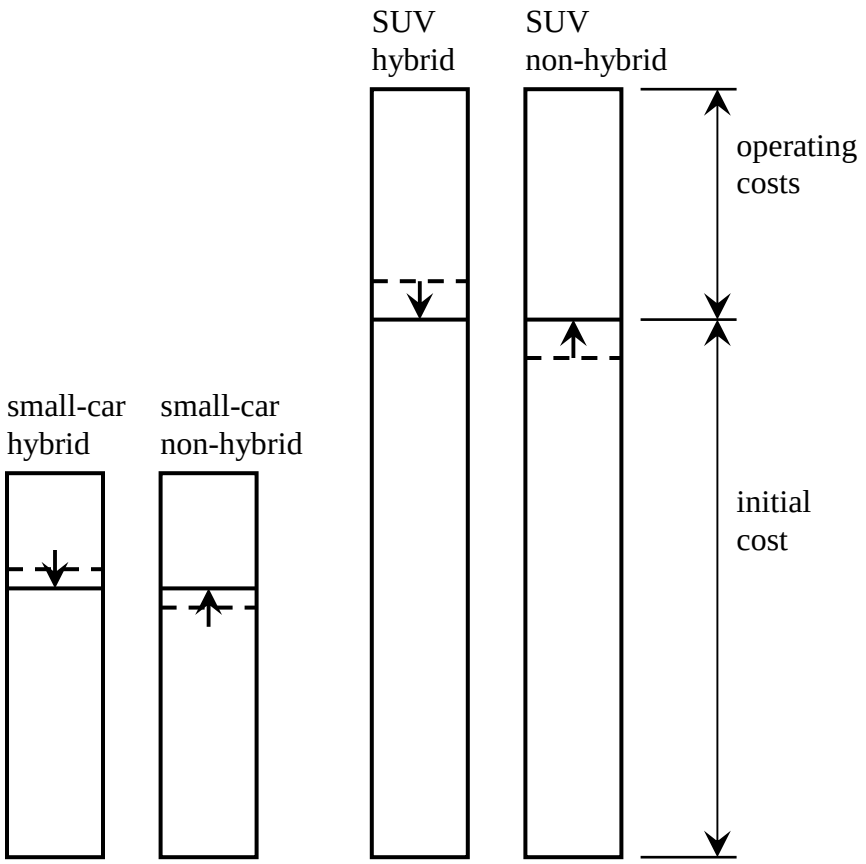

Figure 5. Financing incentive with class- or attribute-dependent benchmark

Feebates could be based on the LEV classification used by the Pavley regulations, with separate benchmarks applying to the two LEV classes. The LEV classification helps to make the Pavley standards feasible for both large and small vehicles, and avoids large disparities in compliance costs. However, the two-class LEV system may be overly simplistic when applied to feebates amounting to several thousand dollars per vehicle.

An alternative would be to base the classification system on a vehicle attribute such as sale price (or dealer invoice). If the benchmark is a function of price, it would have the effect of levelizing operating costs between vehicles within the same price category. To the extent that vehicles having similar utility characteristics have similar prices, this will motivate a buyer to favor vehicles within his or her preferred utility class that have the lowest total lifecycle costs.

Administration

A clean-car financing program would apply to California-registered vehicles of a certain model year (e.g. 2012) and later. This would include any vehicle that is purchased out-of-state and is subsequently registered in California, and it excludes vehicles that are purchased in California and are subsequently registered out-of-state.

Loan payments or fee refunds would be paid in annual installments over the expected vehicle lifetime (e.g. as an adjustment to DMV fees). One option would be to prorate annual payments by vehicle miles traveled (as evidenced by odometer readings). This approach would maintain a more precise balancing of loan or refund payments and actual operating costs, but would be administratively more complex.

An imported used vehicle would be subject to a feebate, which would be prorated based on the vehicle's age (or VMT). Subsequent loan payments and fee refunds would be the same as if the vehicle had been purchased new in California. The application of feebates to imports would tend to encourage importing low-emission vehicles and discourage importing high-emission vehicles.

If a vehicle is exported from California, the owner would be required to make a lump-sum payment of any loan balance due, or would receive a lump-sum payment for any residual fee refunds. This would tend to discourage the export of low-emission vehicles and encourage the export of high-emission vehicles.

Premature vehicle scrappage would be treated as an export. This would discourage scrappage of low-emission vehicles and would encourage scrappage of high-emission vehicles.

Manufacturer interests

Clean-car financing incentives would serve manufacturers' interests in several ways:

Incentives would be preferable to more stringent state standards, such as Pavley II, which would impose inflexible requirements differing from harmonized federal standards and would give manufacturers less flexibility in responding to consumer demand.

The new federal standards would be cost-effective based on operating cost savings, but there is no assurance that there will be much demand for more efficient vehicles if consumers do not sufficiently value operating cost savings.

Financing incentives would overcome this obstacle by making regulation-compliant vehicles more economical for consumers and more profitable for manufacturers.

The incentives could make the market less susceptible to fluctuations in fuel prices. (For example, the incentive level could be based on a three-year average of fuel prices to mitigate impacts of price volatility.) The financing incentives could allow manufacturers to profitably shift their fleet mix to vehicles exceeding federal standards as a strategy for minimizing their risk exposure to future fuel price increases and volatility.

Vehicle financing incentives in the context of cap-and-trade

If LDV fuels are covered by a cap-and-trade system (e.g., AB 32 or the Waxman-Markey federal legislation), then emission trading could nullify any environmental benefit of clean-car financing. The program could nevertheless provide benefits associated with fuel economy, but unless it would at least potentially result in reductions in aggregate emissions it would merely be a fuel economy program and would not be relevant to climate policy. If clean-car financing is implemented under authority of AB 32, then the legislative mandate requiring "the maximum technologically feasible and cost-effective greenhouse gas emission reductions" makes it clear that regulatory incentives should be employed to reduce aggregate emissions.

The surplus emission allowances that are freed up by the financing incentives would somehow need to be taken out of the trading market and retired to ensure that the incentives result in additional emission reductions. There are several possible mechanisms that could be used to do this.

One approach would be to require the surrender of allowances allocated to transportation fuels. The number of allowances surrendered would equate to the regulated LDV sector's overcompliance with the applicable emission standard (Pavley or comparable federal standards).

If the cap-and-trade system does not provide the state authority to require the surrender of surplus allowances, then an alternative approach would be to purchase and retire the allowances. The allowance cost would probably be a very small fraction of the cost savings. One gallon of fuel equates to approximately 0.01 ton of CO_2 emissions, so at an emission price of, say, $20/ton, a vehicle's total emissions would have a trading value equivalent to $0.20/gal. If financing incentives result in 10 percent overcompliance with the standard, then the resulting surplus emission allowances could be purchased at a cost of $0.02/gal. (The allowance purchase funds could be obtained either from gasoline taxes or from feebate revenue.) But if the gasoline price is approximately $2.00/gal, then vehicle efficiency improvements that result in 10

percent overcompliance would yield savings equivalent to a $0.20/gal reduction in fuel prices. Thus, only about one-tenth of the savings would need to be used to take the surplus allowances off the market.

Surplus allowances could also be retained by imposing a price floor on auctioned allowances. If allowances are selling at the floor threshold, then additional emission reductions from LDV's would not result in reduced emission prices; instead the quantity of allowances issued would decrease accordingly. But if the market price is above the floor level, then LDV overcompliance would serve to reduce other sectors' compliance costs without reducing aggregate emissions.

Another approach, which would be similar to a price floor, would be to require surrender or purchase of surplus allowance, but with the quantity of surrendered or purchased allowances being determined or limited by the market price.

Statutes

The above-described financing incentive program is based on the legislative policy of California's AB 1493 legislation (Pavley, 2002)[13], which is the statutory authority for the Pavley I regulations. AB 1493 required CARB to "develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles." The statute defined cost effectiveness to mean "Economical to an owner or operator of a vehicle, taking into account the full life-cycle costs of a vehicle."

As noted previously, CARB estimates that emission reductions beyond the Pavley I requirements would yield net savings of $262/MT (primarily due to fuel savings). This establishes that the Pavley I regulations fall short of the maximum-reduction objective of AB 1493. The shortfall is largely due to predictive uncertainty. Limits of feasibility and cost-effectiveness cannot be reliably predicted, so standard-based regulations must necessarily be biased toward cost conservatism.

A feebate-type incentive mechanism would be less limited by predictive uncertainty, but AB 1493 explicitly prohibited the imposition of new fees. It should be recognized, however, that the revenue flows created by a revenue-neutral feebate would not be fundamentally different from the "wealth transfer" created by emission trading under a tradable standard. A feebate-type financing instrument, which avoids such wealth transfers, might have been compatible with AB 1493, but no such policy was proposed or considered in the rulemaking process.

[13] Clean Car Standards - Pavley, Assembly Bill 1493 [http://www.arb.ca.gov/cc/ccms/ccms.htm]

California's more recent AB 32 legislation (Nunez, 2006)[14], which is currently in its regulatory implementation phase, has language similar to AB 1493 requiring CARB to "adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions from sources or categories of sources …". The statute does not prohibit the use of feebate-type incentives, and it specifically requires CARB to "identify and make recommendations on … potential monetary and nonmonetary incentives for sources and categories of sources that the state board finds are necessary or desirable to facilitate the achievement of the maximum feasible and cost-effective reductions of greenhouse gas emissions by 2020." However, AB 32 does not define "cost-effective" (in the adjective sense), and CARB has not adopted the AB 1493 definition ("Economical to an owner or operator of a vehicle …") for the purpose of regulating passenger vehicles under AB 32.

Unless CARB formally adopts the AB 1493 cost-effectiveness criterion for AB 32 implementation, a feebate-type financing program such as that described above might not fit within the AB 32 regulatory framework and may need to be pursued through separate legislation.

[14] Assembly Bill 32 Implementation and ARB Activities [http://www.arb.ca.gov/cc/cc.htm]